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VARIATION IN *GYNURA DRYMOPHILA* (F. MUELL.) F.G. DAVIES (ASTERACEAE: SENECIONEAE)

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Summary

On the basis of a comparative growth experiment with subsequent morphological and anatomical investigations, *Gynura drymophila* (F. Muell.) F.G. Davies is considered to be a variable species, comprising two varieties. *G. drymophila* var. *glabrifolia* var. nov. is described. Notes on the distribution, habitat and conservation status of the varieties are provided.

The genus *Gynura* Cass. (Asteraceae) has been revised for Malesia and Australia (Davies 1981), with one species *G. drymophila* (F. Muell.) F.G. Davies recognised to occur in Australia. Predominantly Asian (Davies 1979), the genus in Australia comprises two species, *G. drymophila* and one undescribed (R.J. Henderson, pers. comm. 1986).

In her 1981 account Davies provided a description for *G. drymophila* which was apparently based on examination of relatively few dried collections from BM and K. There are several obvious discrepancies in the morphological description when compared with fresh material and the account does not indicate the much wider distribution of this species, nor does it make any comment on its habitat. In fact Davies's distribution map ignores the south-eastern Queensland locality of the type collection giving only far north-eastern coastal Queensland for the species. During field collecting in south-eastern Queensland, several populations of *Gynura drymophila* were encountered that were at variance with the descriptions for the species by Davies (1981) and Stanley and Ross (1986). These plants differed either in floral dimensions or in vegetative characters such as the presence or absence of pubescence.

Reported here are the results of a study of living plants with recourse to dried material for general distribution and typification.

Materials and Methods

The holdings of *Gynura* at BRI and selected material at K were examined.

Plants from six populations sampled (populations 1–6 in Table 1) were grown individually in pots in a peat:sand mixture (50:50) under 30% shading sarlon cloth for up to two years. The vegetative and reproductive material that developed in this period provided the majority of data utilised in the study.

Table 1. Collection sites for *Gynura drymophila* populations studied in cultivation or from live material (All vouchers at BRI)

No.	Location	Lat.	Long.	Voucher
1	Mt Perry	25°12′S,	151°41′E	Forster 2115
2	Mt Edwards	28°02′S,	152°33′E	Forster 2397
3	2km SW of Boolbunda Rock	25°08′S,	151°41′E	Forster 2425
4	Carlisle Island	20°37′S,	149°18′E	Batianoff s.n.
5	Windsor Tableland	16°25′S,	145°02′E	Tucker 91
6	Flinders Peak	27°49′S,	152°49′E	Forster 2735 & Orford
7	Black Gin Ck	25°29′S,	151°55′E	Forster 2909
8	Ben Lomond	28°06′S,	152°44′E	Bird & Bellotti AQ436143, AQ436144

For study of leaf anatomy, leaves approximately 8 cm long from cultivated plants were fixed in FAA, dehydrated through a tertiary butyl alcohol series (Johansen 1940) and cross-sectioned at 7μm. Sections were cut at two positions on the leaf, **(1)** the middle of the lamina which was also usually the broadest position, **(2)** 0.5 cm from the bottom of the lamina. Non-permanent epidermal strips of both upper and lower epidermis were prepared from these two positions. Upper and lower surfaces from populations 1–3 (**Table 1**) from the widest point of the lamina, between the midrib and edge were sputter coated with gold and viewed in a Phillips 500 Scanning Electron Microscope.

For studies of floral morphology, capitula from cultivated plants of populations 1–6 in Table 1 were sampled (between 0700 and 1000 hours) as well as those of the two populations obtained subsequently to the comparative growth experiment (*viz* Forster 2909, Bird & Bellotti AQ436143, 436144).

Results

Pubescent-leaved plants (populations 1,2,4,5,7, and 8[AQ436144] in **Table 1**) possessed uniseriate multicellular trichomes (**Fig. 1A,1C**) whereas plants that appeared glabrous to the naked eye (populations 3,6, and 8[AQ436143]) showed no evidence of trichome initiation (**Fig. 1B,1D**). Similarly the leaf cross-sections of the glabrous plants did not provide any evidence of abscissed trichomes or trichome initiation, in comparison to the pubescent plants which had noticeable multicellular trichomes. Little variation was evident in epidermal cell patterning with the more pronounced ridging on the surface of the glabrous leaf lamina examined in the SEM (**Fig. 1B,1D**) being due to excessive drying of the sample under vacuum. Leaf shape is quite variable on any one plant with laminas ranging from totally entire to strongly dissected (**Figs 2,5**). Leaves of the pubescent plants are generally more weakly concave adaxially, grey green and less rigid when fully turgid, in comparison to the strongly concave, light-green and strongly rigid (when fully turgid) leaves of the glabrous plants (**Figs 2,4**).

No major morphological differences (apart from presence or absence of hairs) were discernible in epidermal strips from the various populations. Stomata were evenly distributed over the leaf surface but more frequent on the lower epidermis.

From the leaf cross-sections examined no major morphological differences were observed in the shape, size or number of various cell types such as epidermis, hypodermis, palisade and spongy mesophyll or vascular tissue.

Capitula from the various populations did not vary significantly in bract number, phyllary number, pappus structure, style and stigma size or morphology, or corolla colour and shape, apart from population 5 where the overall capitulum diameter was 6–7 mm in comparison to 7–9 mm for the other populations studied. Staminal filaments from flowers of the glabrous plants (populations 3,6, and 8[AQ436143]) were often swollen below the anther (**Fig. 5B**), whereas those from some of the pubescent plants (populations 1,2,4,5,7) were generally not (**Fig. 3E**). This distinction did not prove to be reliable and appears to be dependent on the age of the flower, as flowers of pubescent plants collected at around 1600 hours tended to have anther filaments indistinguishable from those of glabrous plants.

Phyllaries from capitula of the glabrous plants were devoid of hairs whereas those of the pubescent plants had similar hairs to those found on the leaves.

Discussion

Pubescence is a common morphological feature used in the delimitation of both specific and infraspecific taxa in many plant groups. In many cases this feature may be under close genetic control and be rigidly selected for or against in differing environments. An excellent example is provided with various populations of *Encelia* (Asteraceae) as studied by Ehleringer and colleagues in north and south America. In *Encelia farinosa*, a species from hot, arid habitats, the presence of leaf pubescence results in decreased leaf absorptance of solar radiation and consequently decreased leaf temperature and transpiration, in comparison with leaves of a glabrous leaved species, *E. californica* from mild, wetter habitats (Ehleringer & Bjorkman 1978, Ehleringer & Mooney 1978). The distribution of other pubescent/glabrous species-pairs of *Encelia* is essentially parapatric

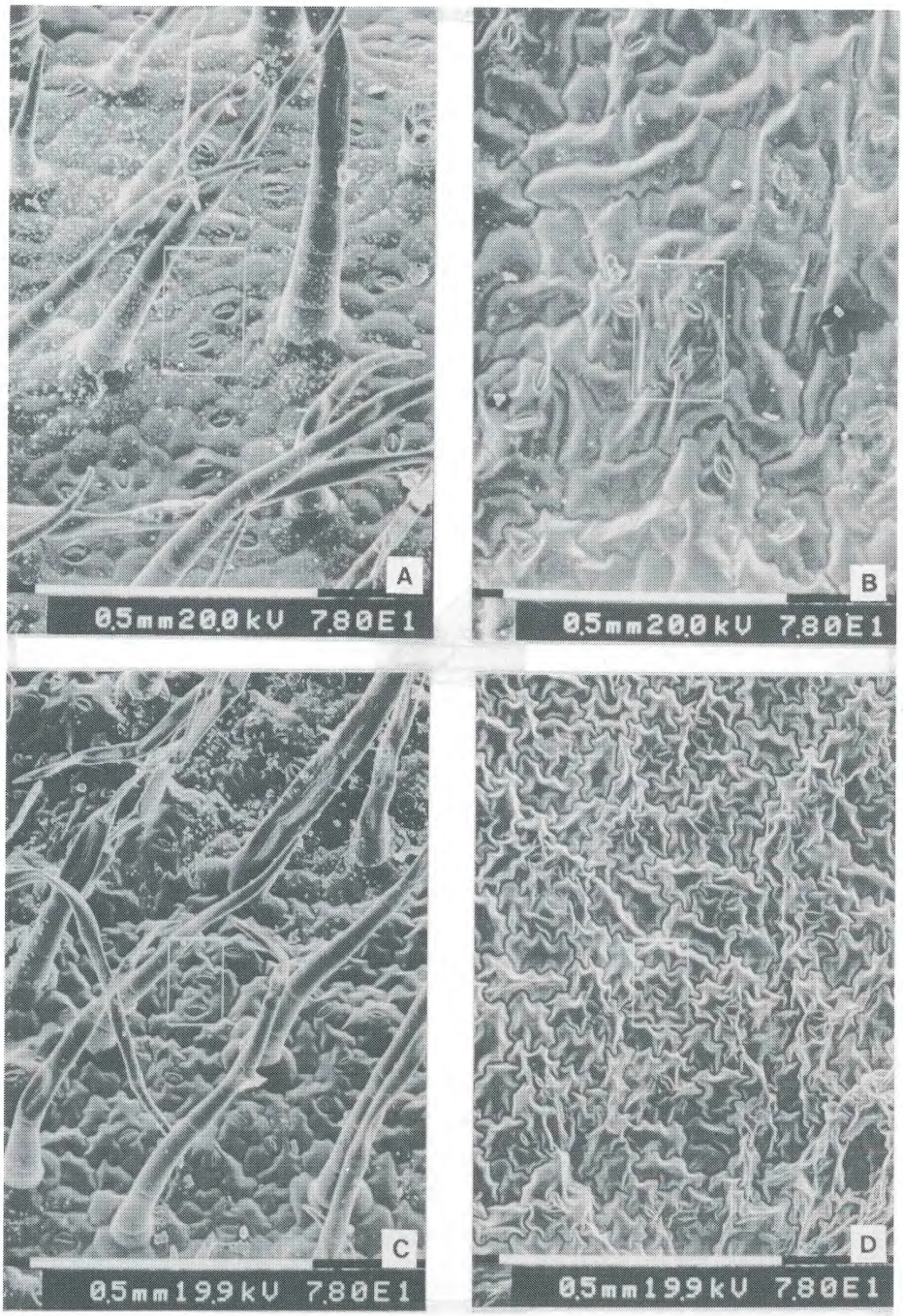

Fig. 1. SEM photographs. A–B upper leaf surface: A. *Gynura drymophila* var. *drymophila*, B. *G. drymophila* var. *glabrifolia*. C–D lower leaf surface: C. *Gynura drymophila* var. *drymophila*, D. *G. drymophila* var. *glabrifolia*. A,C Forster 2115; B,D Forster 2425.

with occurence of the various taxa being related to vegetation type (Ehleringer *et al.* 1981). Where overlap does rarely exist, hybridisation between species occurs with intermediately pubescent individuals resulting.

A similar morphological situation appears to exist with *Gynura drymophila* in eastern Australia, with both glabrous and pubescent populations occurring, but usually in different habitat types throughout much the same overall distribution range. In all populations studied in the field, except for that at Ben Lomond (Bird & Bellotti AQ436143, 436144), plants are either entirely glabrous or entirely pubescent.

Where populations are in close geographical proximity (e.g. populations 1 and 3) the rock type of the substrate and associated species are different. Pubescent populations are known to occur on rhyolite at Mt Perry, Mt Edwards, Mt Walsh (Crisp 2635), Black Gin Creek (Forster 2909) and Glen Rock, Esk (D. Orford, pers. comm. 1986) and glabrous populations on trachyte at Flinders Peak and intruded granite 2km SW of Boolbunda Rock. Examination of the Ben Lomond population (13 Feb 1988) revealed an interesting distribution of plants in the habitat. On the more restricted outcroppings of highly weathered rhyolite, a mixture of glabrous and pubescent plants occurred (roughly 3:1 for approximately 20 plants seen). On the more predominant, lightly weathered rhyolite cliff lines, only pubescent plants occurred. Occasional plants of either type occurred in adjacent eucalypt forest among long grass where survival rates with respect to fire would be expected to be low.

Both pubescent and glabrous populations occur in high light environments, and the function of pubescence remains to be investigated. It is probable that pubescence is important in the reflection of incident radiation as was found for *G. aurantiaca* DC. (Gausman & Cardenas 1969), a mesomorphic species (Fahn 1986) from Java, but whether to the same extent as in *Encelia* remains to be seen. Lightly weathered rhyolite tends to shed moisture very quickly, whereas highly weathered rhyolite, intruded granites and trachytes tend to be more moisture retentive (M.F. Olsen, pers. comm. 1988), so perhaps the different morphological forms of *Gynura drymophila* differ in tolerance to water deficit stress. This also remains to be investigated.

G. drymophila may be considered as a species in the process of differentiation into different habitat forms and appears to encompass two distinct genetic groups that differ primarily in pubescence, but also show some slight difference in anther-filament swelling and leaf colour and rigidity. As the character of foliage pubescence is consistent both within and between different populations over a wide range and does not change under conditions of uniform cultivation, it is considered that two distinct varieties of *G. drymophila* occur. As the pubescent variety is far more commonly encountered and more widely distributed, it is considered that the glabrous variety has arisen independently at several localities. This glabrous variety is now established at several localities on parent volcanic material of differing types from that with the pubescent variety present, except at Ben Lomond where both occur on rhyolite, albeit under differing weathering regimes.

GYNURA DRYMOPHILA

Gynura drymophila (F. Muell.) F.G. Davies, Kew Bull. 35: 733 (1981) ("*drymophilus*").

Senecio drymophilus F. Muell., Trans. & Proc. Philos. Inst. Victoria 2: 69 (1857). **Lectotype** (designated here): Australia, Brisbane River, Oct. 1856, *Hill & Mueller* (holo: K (photo seen); iso: K (photo seen, mixed sheet with Dallachy collection), MEL? *n.v.).*

Gynura pseudochina auct. non (L.) DC.; Benth., Fl. austral. 3: 661 (1867); F. Muell., Syst. census Austral. pl. 84 (1882); Second Syst. census 142 (1889); Bailey, Syn. Queensl. fl. 265 (1883); Cat. pl. Queensland 26 (1890); Queensl. fl. 3: 873 (1900); Queensland Agric. J. 28: 198 (1912); Compr. cat. Queensland pl. 275 (1913); Domin, Biblioth. Bot. 89: 1239 (1929).

Senecio shirleyanus Domin, Biblioth. Bot. 89: 1240 (1929). **Type:** Süd-Queensland, Regenwälder der Tambourine Mts, in der Nähe der Wasserfälle, Mar 1910, *Domin* (holo: PR, photo!).

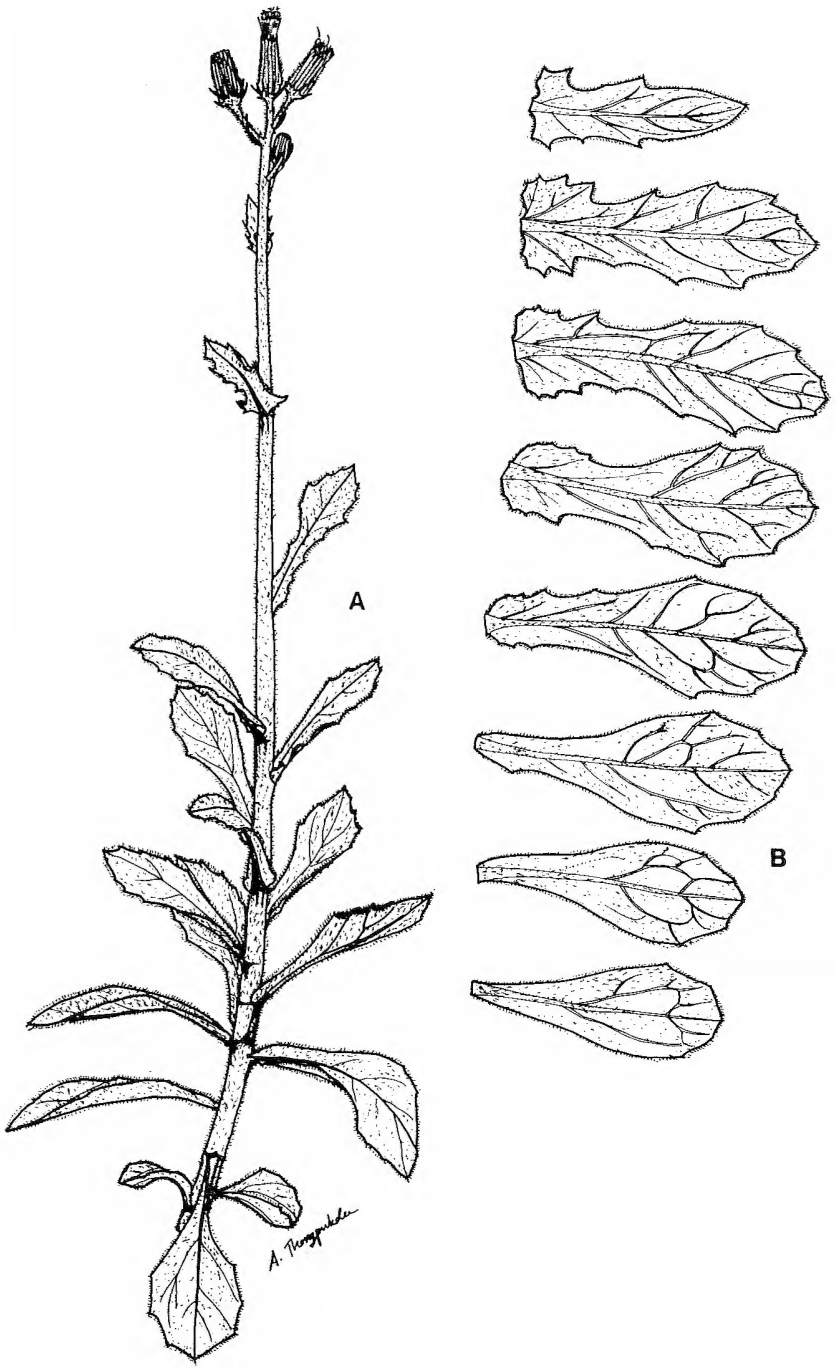

Fig. 2. *Gynura drymophila* var. *drymophila*: A. habit × 0.45. B. leaf series from base of stem to base of inflorescence (top to bottom) × 0.45. A,B Forster 2397.

Succulent herbaceous perennial or biennial to 50 cm high, base woody, to 10 cm diameter. Basal leaves petiolate, petiole 1–3 cm long; upper leaves sessile; margin irregularly toothed; blades obovate, ovate-oblong or narrowly ovate; light-green to grey-green, sometimes purplish in adaxial interveinal areas; scabrous, secondary veins indistinct, 3–6 pairs; apex obtuse; 5–16 cm × 1–6 cm. Inflorescence terminal, 20–40 cm long, light-green to grey-green with purplish blotching; with 2–3 branches 20–30 cm long, each bearing 1–3 capitula on light-green peduncles 20–50 cm long. Capitulum campanulate, 6–9 mm diameter; subtended by *ca* 10 linear, light-green purple-tipped bracts, 7–10 mm × 1 mm; 30–50-flowered. Phyllaries 13, linear, 15–18 mm long, light-green. Corolla 14–15 mm long, orange-yellow, limb 4 mm long; lobes acute, cucullate, 0.8–1 mm long. Style 18–20 mm long, orange-yellow, glabrous. Stigma *ca* 2 mm long, minutely puberulous, orange-yellow. Ovary *ca* 3 mm × 0.75 mm, light-green. Stamens 5, in collar around style. Anthers 1.6–1.7 mm × 0.23–0.26 mm, colourless. Filaments 0.8–1 mm × 0.06–0.09 mm; colourless. Achenes 1.5–6 mm long, pale to dark brown, pappus of 140–160 filiform, translucent, minutely spiculate hairs, 7–13 mm long.

Senecio shirleyanus described by Domin (1929) from Mt Tamborine, is considered by R.O. Belcher (pers. comm. 1986) to be a synonym of *G. drymophila*. A photograph of the type (PR) in the possession of Dr Belcher showed a plant with pubescent foliage.

Key to Varieties

Plant pubescent	**1. G. drymophila** var. **drymophila**
Plant glabrous	**2. G. drymophila** var. **glabrifolia**

1. G. drymophila var. drymophila

Foliage pubescent, grey-green (live). Leaves when fully turgid, weakly rigid and weakly concave adaxially.

Specimens examined: Queensland. COOK DISTRICT: Windsor Tableland, 16°25′S, 145°02′E, Oct 1986, *Tucker* 91 (BRI). NORTH KENNEDY DISTRICT: Holbourne Is, Great Barrier Reef, 19°45′S, 148°21′E, Mar 1971, *Heatwole* AQ007728 (BRI); Edwards Is, Great Barrier Reef, 20°15′S, 149°15′E, May 1969, *Heatwole* AQ006477 (BRI); Hayman Is, Jun 1934, *White* 10146 (BRI); Long Is, Jul 1935, *White* 12170 (BRI). SOUTH KENNEDY DISTRICT: Bailey Islet, Great Barrier Reef, 21°02′S, 149°33′E, May 1969, *Firth* AQ007888 (BRI); Carlisle Is, Sep 1986, *Batianoff* AQ451404 (BRI); The Neck, Shaw Is, 20°29′S, 149°09′E, Nov 1985, *Batianoff* 3151 & *Dalliston* (BRI). LEICHHARDT DISTRICT: Brigalow Research Stn, 20 miles [32 km] NW of Theodore, Sep 1967, *Johnson* 2689 (BRI). PORT CURTIS DISTRICT: Pine Islet, Great Barrier Reef, 21°39′S, 150°13′E, Feb 1971, *Heatwole* AQ006401 (BRI); S Percy Isles, Mar 1906, *Tryon* AQ247920 (BRI); Rockhampton, undated, *Dallachy* s.n. (K, mixed sheet with isolectotype). BURNETT DISTRICT: Mt Perry, 25°12′S, 151°41′E, undated, *Keys* 926 (BRI); ditto, Aug 1985, *Forster* 2115 (BRI). WIDE BAY DISTRICT: The Gorge–Biggenden Bluff, May 1931, *White* 7739 (BRI); Coast Range, Biggenden Shire, Feb 1981, *Randall* 5 (BRI); Mt Walsh, 6 km S of Biggenden, 25°34′S, 152°02′E, May 1977, *Crisp* 2635 (BRI,CBG); Black Gin Ck, T.R. 580, 25°29′S, 151°55′E, May 1987, *Forster* 2909 (BRI). MORETON DISTRICT: McPherson Range, Feb 1912, *Anon.* AQ247923 (BRI); Taylor's Range, Feb 1917, *Bailey* AQ247925 (BRI); Upper Ithaca Ck, undated, *Bailey* AQ247928 (BRI); Mt Edwards, 28°02′S, 152°33′E, Mar 1986, *Bird* AQ399794 (BRI); ditto, *Forster* 2397 (BRI); Tambourine Mt, Feb 1917, *Tryon & White* AQ247926 (BRI); Mt Greville, Jun 1963, *Pedley* 1265 (BRI); 1 km E of the Sawmill on Border road, 18 km S of Main road from Boonah to Rathdowney, Apr 1973, *Sharpe* 375 (BRI); Shipstern Range, Lamington N.P., Jul 1945, *Blake* 5841 (BRI); Ben Lomond, 28°06′E, 152°44′E, Jan 1987, *Bird & Bellotti* AQ436144 (BRI).

Habitat and Conservation Status: *G. drymophila* var. *drymophila* often occurs in cracks or detritus of rhyolitic rocks or alternatively on deep sand. Mainland populations may be associated with *Eucalyptus acmenoides* Schauer/*Casuarina torulosa* Salisb. dominated communities, often in high rainfall areas (>1300mm per annum) at an altitude from near sea level to over 800 m. Plants (especially if lithophytic) may be found in association with other succulent or semi-succulent plants such as *Hoya australis* R. Br. ex Traill. (Asclepiadaceae), *Peperomia leptostachya* Hook. & Arn. (Peperomiaceae), *Plectranthus graveolens* R. Br. and *P. parviflorus* Willd. (Lamiaceae).

G. drymophila var. *drymophila* is infrequently collected and is relatively rare at some of its recorded localities (e.g. Mt. Perry) with an attempt to recollect material at the locality of Sharpe 375 being unsuccessful. At this stage it is not endangered.

Both von Mueller (1889) and Maiden and Betche (1916) record *G. drymophila* (as *G. pseudochina*) as occurring in New South Wales, but Jacobs and Pickard (1981) discount these records. Some of the Queensland localities are very close to New South Wales (e.g. Sharpe 375) and as similar rock types occur over the border, then the species could well occur there.

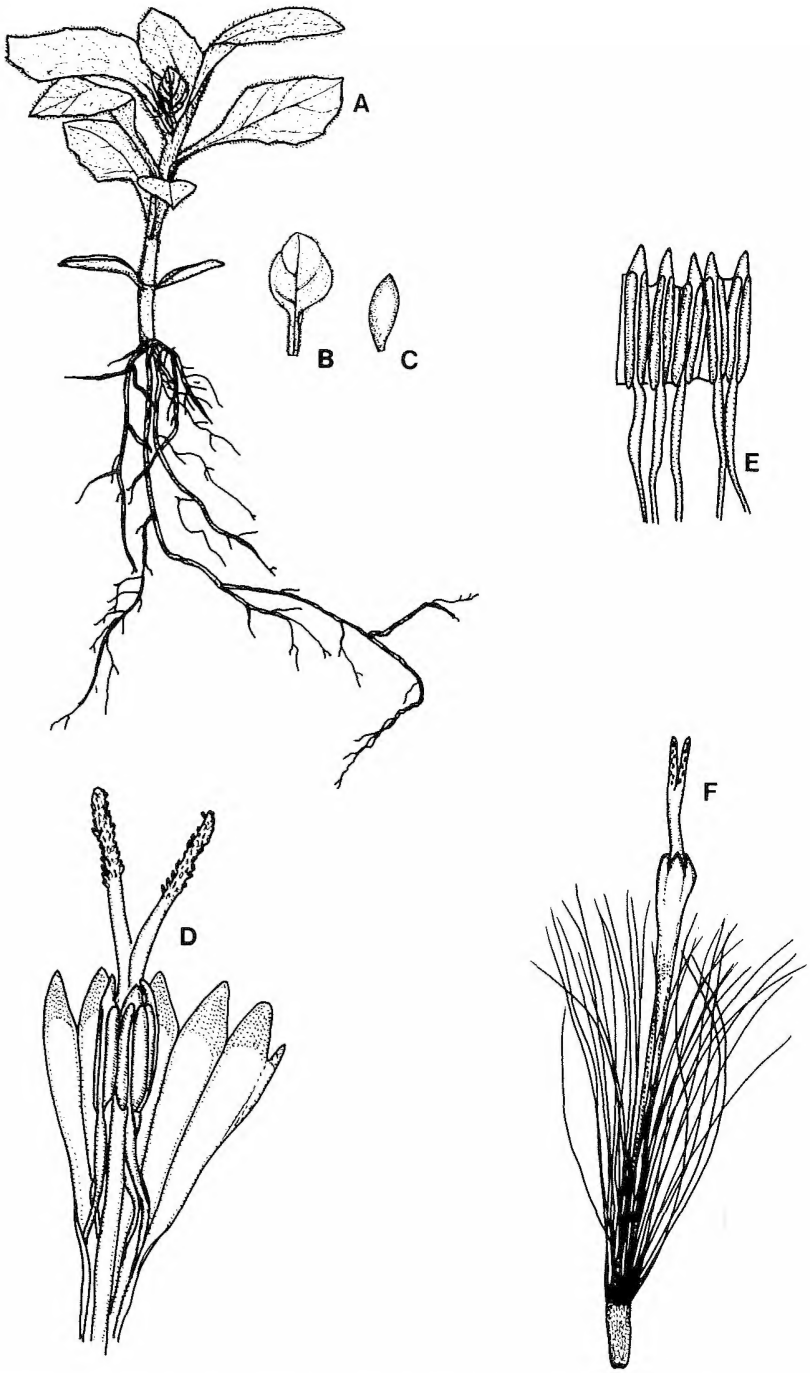

Fig. 3. *Gynura drymophila* var. *drymophila*: A. seedling × 0.45. B. first seedling leaf × 0.45. C. cotyledon × 0.45. D. dissected floret showing anthers around style × 8. E. anthers (note no filament thickening) × 8. F. floret × 3.5. A–C Forster 2115; D–F Forster 2397.

2. G. drymophila var. **glabrifolia** P. Forster & Thongpukdee **var. nov.** a *G. drymophila* (F. Muell.) F.G. Davies subsp. *drymophila* foliis glabris differt. **Typus:** cultivated specimen ex BURNETT DISTRICT: Map Reference: MOUNT PERRY 9247-681198, 2km SW of Boolbunda Rock. 25°08′S, 151°41′E, 15 May 1986, *P.I. Forster* 2425 (holo: BRI+spirit).

Foliage glabrous, light-green (live). Leaves when fully turgid, strongly rigid and strongly concave adaxially.

Additional material examined: LEICHHARDT DISTRICT: Brigalow Research Station, 20 miles [32 km] NW of Theodore, Sep 1967, *Johnson* 2670 (BRI). MORETON DISTRICT: Flinders Peak, 27°49′S, 152°49′E, Nov 1986, *Forster* 2735 & *Orford* (BRI); Ben Lomond, 28°06′S, 152°44′E, Jan 1987, *Bird & Bellotti* AQ436143 (BRI).

Habitat and Conservation Status: The live collections of *G. drymophila* var. *glabrifolia* studied were from exposed trachyte, intruded granite or highly weathered rhyolite outcrops in low heathland with occasional *Eucalyptus* overstorey. Plants were relatively common at the type locality, but only one individual was seen at Flinders Peak. A visit to the Brigalow Research Station near Theodore was unsuccessful in locating any plants of *Gynura* (of either variety) and plants have not been observed at this locality since *ca* 1967 (R.W. Johnson, pers. comm. 1986). From label information on Johnson 2670 and 2689, both varieties occurred in different vegetation types at the Brigalow Research Station.

Unlike *G. drymophila* var. *drymophila*, the distribution of *G. drymophila* var. *glabrifolia* is disjunct over much greater distances, but further field collections on suitable rock types may provide additional localities. A strong possibility is that the new variety is a rarely occurring genetic variant of *G. drymophila* var. *drymophila* and further studies on breeding systems of the two varieties would be of value. An appropriate conservation coding for the new variety is 3R (Leigh *et al.* 1981).

Acknowledgements

Dr R.W. Johnson and Messrs G. Batianoff, L.H. Bird, P.D. Bostock, D. Orford and M.C. Tucker assisted either in discussion of various aspects of this study, collecting material or providing information on localities. Messrs R.J. Henderson and L. Pedley made useful comments on the manuscript and the latter provided the Latin diagnosis. Dr R.O. Belcher kindly allowed examination of his photograph of type material of *Senecio shirleyanus*. Dr G.P. Guymer while Australian Botanical Liaision Officer at Kew, U.K., examined material and arranged for a photograph of the type to be taken. Staff of the Brigalow Research Station, Department of Primary Industries, Theodore provided assistance to one of us (PIF) on a field visit. Staff of the Queensland Geological Survey and Department of Geology and Mineralogy, University of Queensland assisted in rock identification. Mr J. Hardy of the Electron Microscopy Unit, University of Queensland prepared the Scanning Electron Micrographs. Mr J. Bertram, Histologist, Botany Department, University of Queensland sectioned the leaf material.

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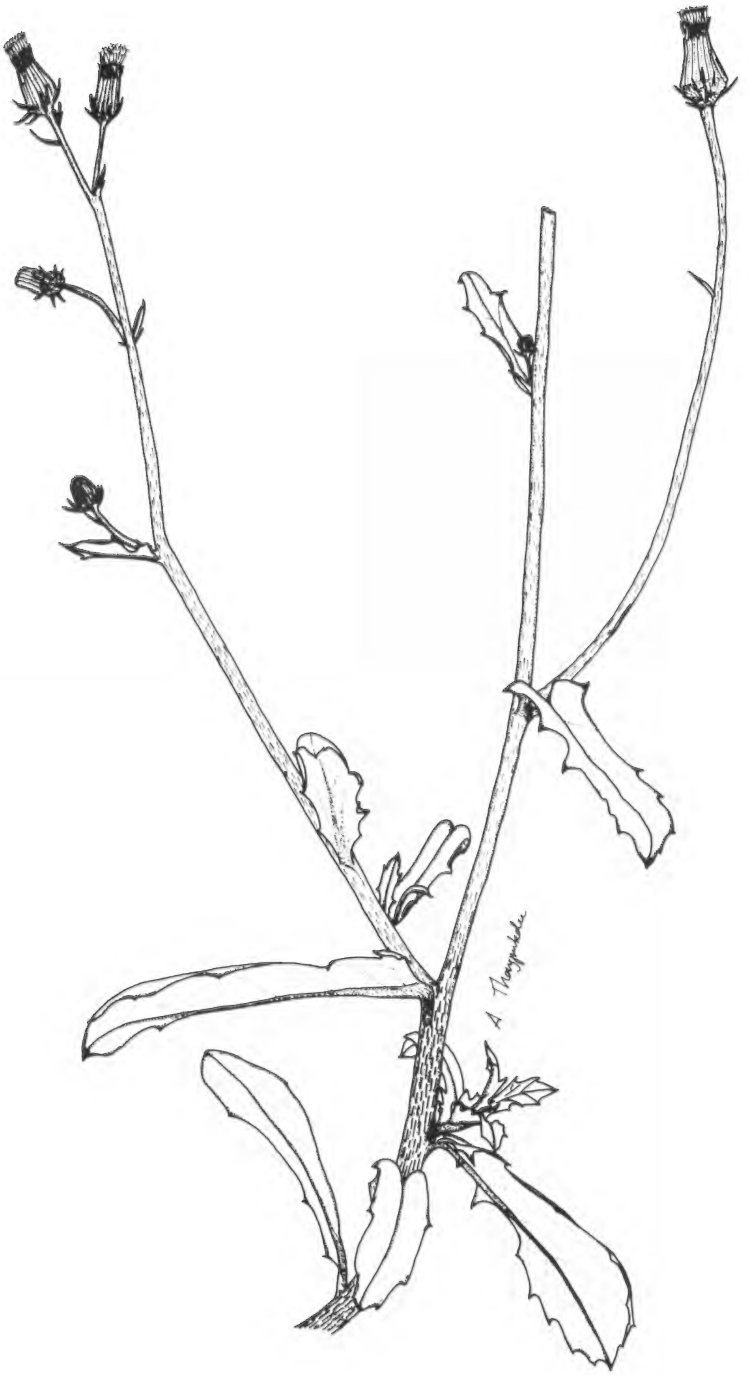

Fig. 4. *Gynura drymophila* var. *glabrifolia*: A. habit × 0.45. Forster 2425.

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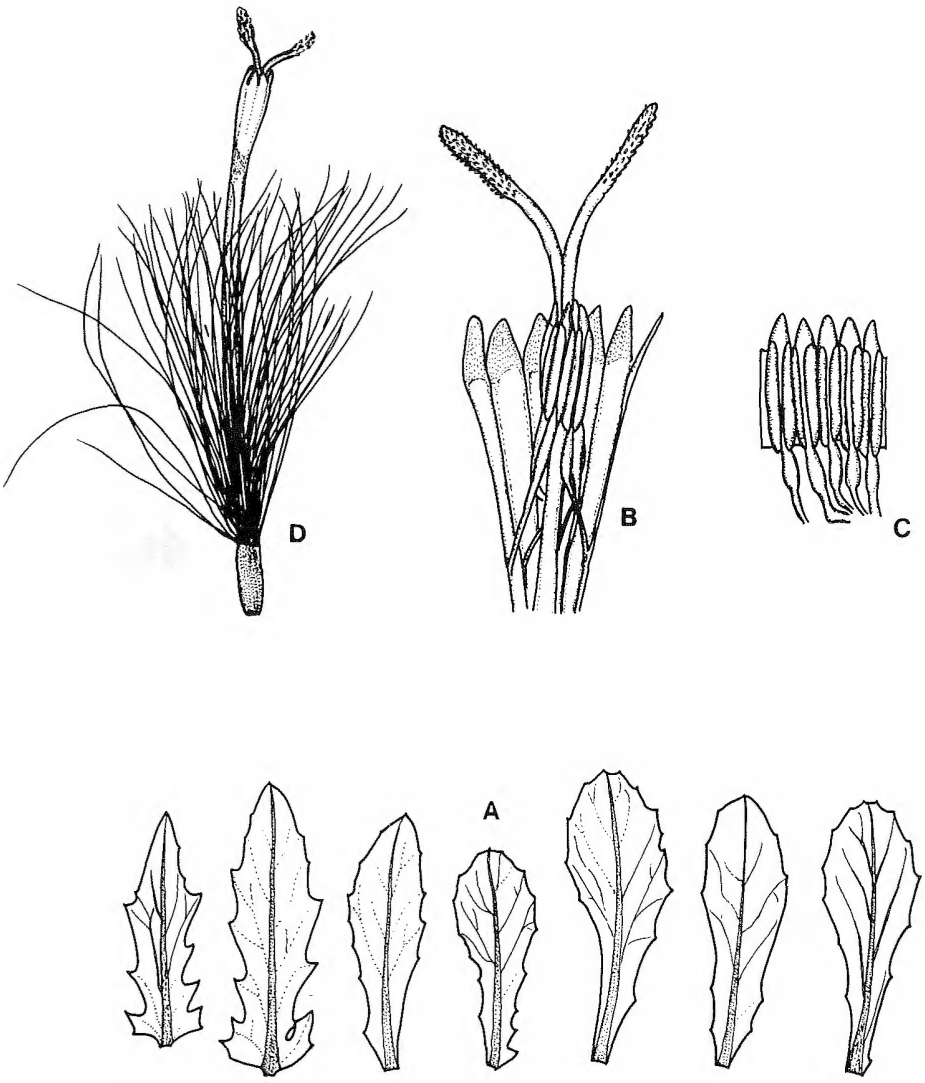

Fig. 5. *Gynura drymophila* var. *glabrifolia*: A. leaf series from base of stem to base of inflorescence (left to right) × 0.45. B. dissected floret showing anthers around style × 8. C. anthers (note filament thickening) × 8. D. floret × 3.5. A–D Forster 2425.